At str July 21

Thursday, July 21, 2022 6:09 PM

Ionization Energy (I.E) or Ionization Potential → Energy required by e^- to make transition from Ground state ($n=1$) to $n=\infty$

⇓ for single e^- species

$$\Delta E_{n_1 \to n_2} = 13.6\, Z^2 \left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right] eV$$

$n_1 \to$ Initial level ($n=1$)

$n_2 \to$ Final level (∞)

$$I.E \text{ or } I.P = \Delta E_{1\to\infty} = 13.6\, Z^2 \left[\frac{1}{(1)^2} - \cancel{\frac{1}{(\infty)^2}}\right] eV$$

$$\boxed{I.E = 13.6\, Z^2}$$

$I.E(He^+) = 13.6 \times 4$ eV $= 2.18 \times 10^{-18} \times 4$ Joule/atom

$I.E(H) = 13.6$ eV

$I.E(Li^{2+}) = 13.6 \times (3)^2$ eV

$I.E(Be^{3+}) = 13.6 \times (4)^2$ eV

$I.E(Be^{3+}) = 2.18 \times 10^{-18} \times 4^2$ J/atom

$= \dfrac{2.18 \times 10^{-18} \times (4)^2}{4.18}$ Cal/atom

1 eV/atom $= 96.5$ KJ/mole

$1\, eV = 1.6 \times 10^{-19}$ J/atom

$= 1.6 \times 10^{-19} \times N_A$ J/mole

$= 96.5 \times 10^3$ J/mole

$= 96.5$ KJ/mole

\# **Seperation Energy (SE)** or **Binding Energy BE**

↳ energy required by e^- to make transition from any excited state to ∞.

$$SE = \Delta E_{n\to\infty} = 13.6\, Z^2 \left[\frac{1}{n^2} - \frac{1}{(\infty)^2}\right] eV$$

$n \Rightarrow$ any level except $n=1$

$$\boxed{SE_n = +13.6 \frac{Z^2}{n^2}\, eV/atom}$$

(**) SE & I.E ⇒ +ve

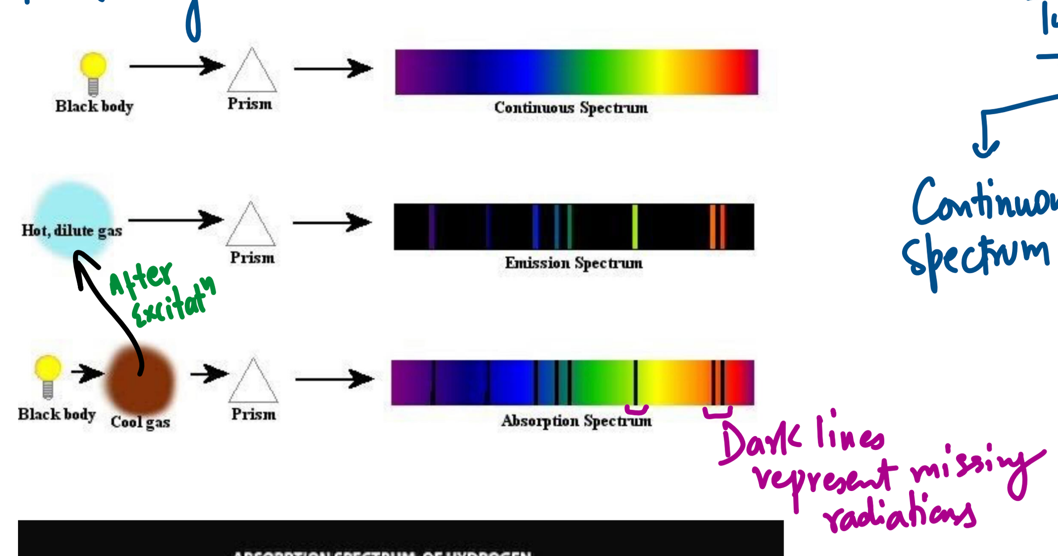
Q3 SE of 2nd Excited state of He^+?

Soln :- $n=3$

$SE_3(He^+) = +13.6 \dfrac{\times 4}{(3 \times 3)}$ eV

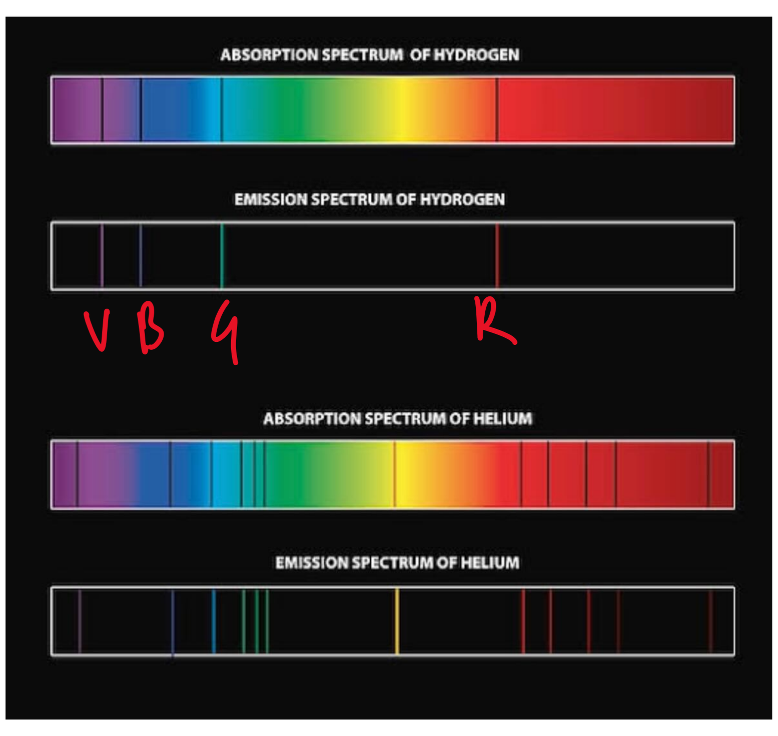
Spectra

Arrangement of radiations on photographic plate on Basis of decreasing or increasing order of λ or ν is called Spectrum.



Types of Spectrum

- Continuous Spectrum
- Line (Discontinuous) Spectrum
  - Emission Spectrum
  - Absorption Spectrum



(*) Emission or Absorption Spectrum of each element is unique & different which is used as fingerprinting of elements

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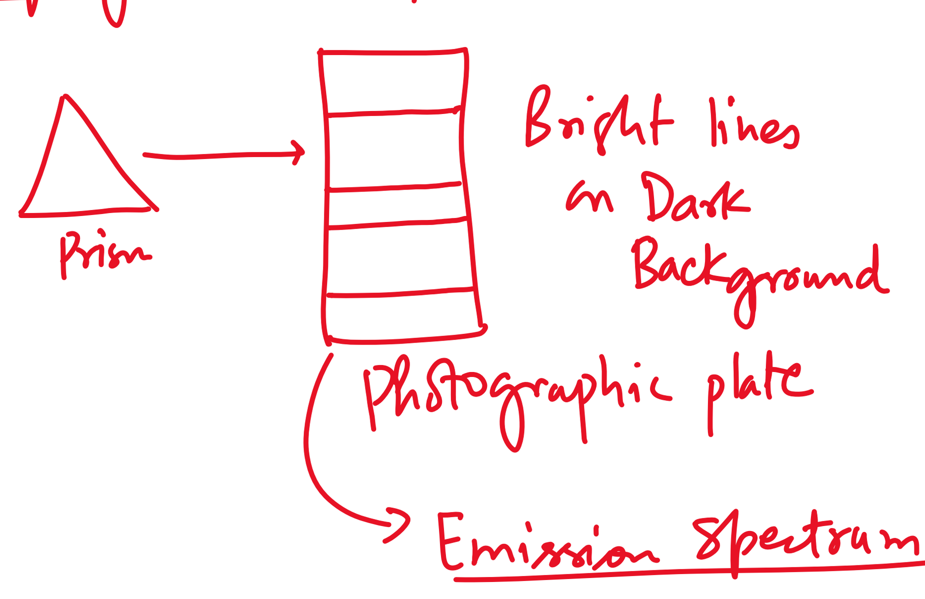
Emission spectrum of Hydrogen (Simplest spectrum)



⇒ Emission spectrum of Hydrogen is observed when Excited H-atoms de-excites i.e, e^- in H-atom make transition from High level to low level.

⇒ Emission Spectrum of H-atom was observed in 3 Regions

i) UV-Region → studied by Lyman

ii) Visible Region → " " Balmer

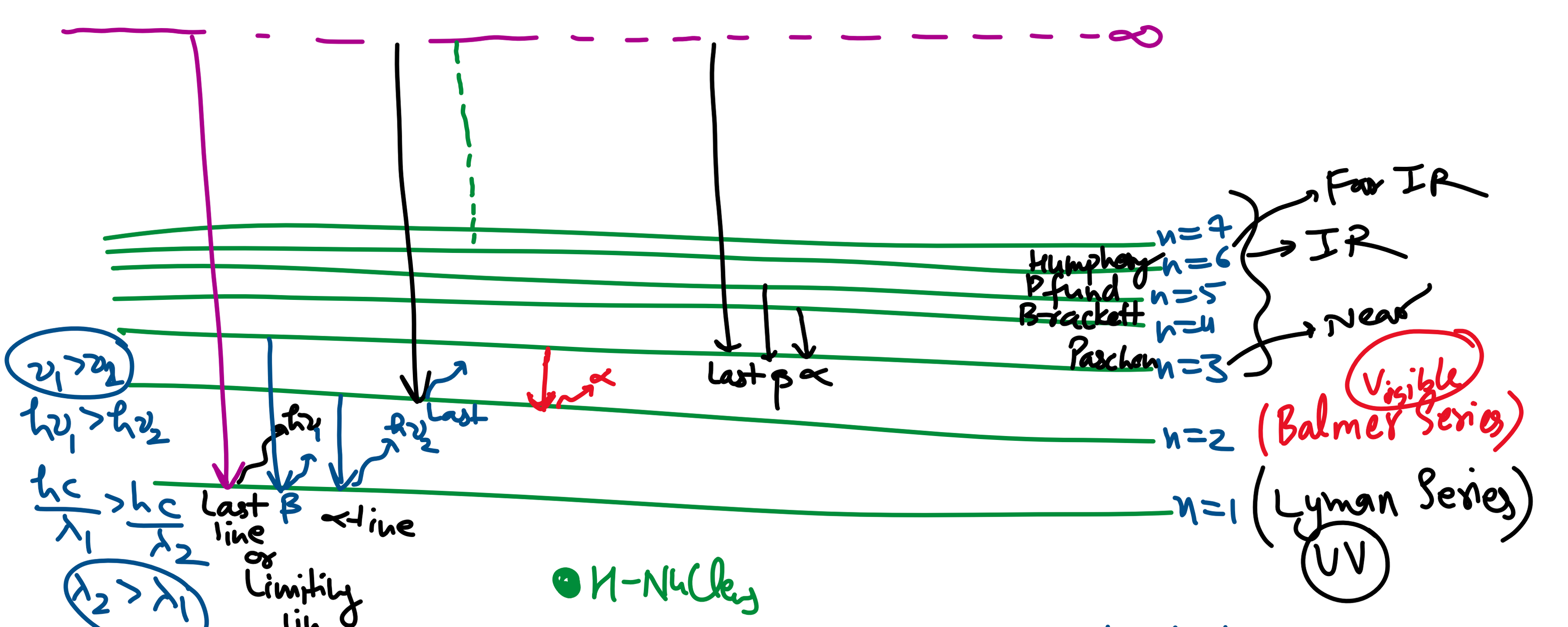
iii) IR-Region → " " Paschen, Brackett, Pfund, Humphery

E →

IR | UV

Vis

R V



Lyman Series

max λ transition ⇒ 2→1 (α-line)

min λ " ⇒ ∞→1 (limiting or last line)

α line ⇒ 2→1

β line ⇒ 3→1

Balmer Series (Visible Radiations) (e^- lands to $n=2$)

α-line ⇒ 3→2 ⇒ λ_{max} → Red line

β-line ⇒ 4→2

γ-line ⇒ 5→2

last line ⇒ ∞→2 ⇒ λ_{min} → Violet

Paschen Series (e^- lands to $n=3$)

4→3 ⇒ α-line, λ_{max} for Paschen Series

∞→3 ⇒ last line

(**) $$\frac{1}{\lambda} = \bar{\nu} = R Z^2 \left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$$ $(n_2 > n_1)$

R = Rydberg const

$(109677\ cm^{-1})$

or

$1.09 \times 10^7\ m^{-1}$

⇓

$\approx 10^7\ m^{-1}$ (for numericals)